REMARKS

Claims 1-7 have been amended, and new claims 8-14 have been added. Claims 1-14 are pending, with claims 1, 6, and 12 being independent.

Attached hereto is an Appendix entitled "Version with Markings to Show Changes Made" which is a marked-up version of the portions of the application which have been amended by the present amendment, with brackets indicating deleted matter and underlining indicating added matter.

In item 13 on page 1 (the Office Action Summary) of the Office Action of August 1, 2002, the Examiner has checked boxes 13 and a) in an attempt to acknowledge the applicants' claim for foreign priority and acknowledge that the certified copy of the priority document has been received. However, the Examiner did not check box 1. Certified copies of the priority documents have been received. as the Examiner was supposed to do to make a complete acknowledgement that the certified copy of the priority document has been received. Accordingly, it is respectfully requested that the Examiner make a complete acknowledge by checking boxes 13, a), and 1. Certified copies of the priority documents have been received. in the next Office communication.

A copy of Japanese reference 10-304235 (including an English abstract) which is cited on page 2 of the specification was submitted on November 21, 2001, when the present application was filed, together with a sheet entitled "Information under 37 CFR 1.56(a) listing this reference. The Office Action of August 1, 2002, includes a copy of this sheet marked by the Examiner to indicate that Japanese reference 10-304235 has been considered. However,

sometimes the PTO does not print references listed on such a sheet filed in an application in the "References Cited" section of a patent issuing from the application.

Accordingly, to ensure that Japanese reference 10-304235 will be listed in the "References Cited" section of any patent which may issue from the present application, attached hereto is a form PTO-1449 listing Japanese reference 10-304235. It is respectfully requested that the Examiner mark the form PTO-1449 to indicate that Japanese reference 10-304235 has been considered, and provide a copy of the marked form PTO-1449 with the next Office communication.

Submitted herewith is a proposed correction to Fig. 3. Corrected formal drawings including the change in this proposed correction will be submitted when required by the Examiner.

The drawings were objected to because of a spelling error in step 3 in Fig. 3. The applicants have proposed to correct this error in the proposed drawing correction submitted herewith, and accordingly it is respectfully requested that the objection to the drawings be withdrawn.

Claims 1-7 have been amended solely to improve their form. No new limitations have intentionally been added to claims 1-7 in an attempt to distinguish them over the prior art. In light of this, it is submitted that it would not be proper for the Examiner to make the next Office Action final if it includes any new ground of rejection of any of claims 1-7 over the prior art.

New dependent claims 8-11 depending from independent claims 1 and 6 have been added to recite further combinations of features of the present invention.

New independent claim 12 and new dependent claims 13-14 depending therefrom have been added to recite the present invention in different terms.

Claims 1-7 were rejected under 35 USC 102(a) as being anticipated by Howell (U.S. Patent No. 6,046,772). This rejection is respectfully traversed, both with respect to claims 1-7 and insofar as the rejection may be deemed to be applicable to new claims 8-14.

Independent claim 1 recites an image processing apparatus comprising an imaging optical system for forming an image of an object on an imaging surface, a color imaging device including a plurality of photo detectors arranged on the imaging surface, each of the photo detectors forming a pixel, and a plurality of sets of four filters for three colors, two filters of the four filters being for a selected color of the three colors, the filters being arranged at positions respectively corresponding to the photo detectors, the image of the object being formed on the photo detectors through the filters by the imaging optical system, shift drive means for shifting the imaging optical system and the photo detectors relative to each other by a distance corresponding to a predetermined number of pixels on the imaging surface, and an image processing unit for generating an image using a plurality of image data picked up before and after the shifting, wherein the image processing unit generates and outputs a single

monochromatic image using only pixel data detected by photo detectors corresponding to the two filters for the selected color of the three colors.

In explaining the rejection of claim 1, the Examiner states as follows:

> In regards to claim 1 Howell et al, herein Howell, discloses all of the necessary information in order to reject all parts of the claimed "image processing apparatus" as noted in the following five paragraphs.
>
> In regards to the claimed "imaging optical system for forming an image of an object on an imaging surface" as claimed in claim 1 Howell discloses a digital camera that has "at the focal plane an array of electronic light-sensitive elements ... that produce a light-intensity-dependant electrical signal in response to being illuminated (column 1, lines 29-33, Howell)."
>
> In regards to the claimed "color imaging device" as claimed in claim 1 Howell discloses an "array of electronic light-sensitive elements (column 1, line 30, Howell)." Howell further discloses "the color matrix in the present invention is based on a unit cell of primary colors that is a mosaic in which half the pixels are one primary color and the rest are divided equally between the two complementary primary colors (column 7, lines 14-18, Howell)." Note figure 3 depicting a "multiplicity of sets of four filters for three colors, two of said four filters being used for selected one of said three colors." Howell still further discloses "the unaided light-sensing elements do not distinguish between different colors of light ... In order to capture the color data needed ... one can use several primary color filters (column 2, lines 28-32, Howell)," or in other words the "object image being formed on said photo detectors through each of said filters by said imaging optical system."
>
> In regards to the claimed "shift drive means for shifting said imaging optical system and said photo detectors relatively to each other by a length corresponding to a predetermined number of pixels in said imaging surface" as claimed in claim 1 Howell discloses "there are means provided in many digital cameras currently in use by which the light-sensitive

array can be shifted by a single pixel ... the present invention utilizes a precision rotation of the digital camera about an axis passing through the principal point of its lens (column 9, lines 28-35, Howell)," whereby the "predetermined number of pixels" is "a single pixel (column 9, line 30, Howell)."

In regards to the claimed "image processing unit for generating an image using a plurality of image data picked up before and after said shift" as claimed in claim 1 Howell discloses "two photographs will serve to record the image in one primary color for every pixel position (column 7, lines 25-26, Howell)." Howell further discloses "between the two photographs the light sensing array is shifted with respect to the image by one pixel (column 7, lines 27-29, Howell)." Howell still further discloses "electronic circuitry/software used to combine the two images produced in the two-shot mode uses the luminous intensity of a particular primary color at all locations in the image to produce an integrated/interpolated image (column 7, lines 31-35, Howell)."

In regards to the claimed "image processing unit generates and outputs a single monochromatic image using only the pixel data detected by the photo detectors having said two filters of a single color" as claimed in claim 1 Howell discloses "as one records," or "outputs," " a series of photographs; each image," or "single ... image," captured will depict the scene as it appears in one primary color (column 2, line 35, Howell)," or "monochromatic," wherein one of the "series of photographs (column 2, line 33, Howell)" is of the color green as disclosed in figure 6. Howell further discloses from figure 6 that "the result of having taken the two single shots will be to obtain actual measurement data for green for every single point (column 9, lines 8-10, Howell)," or a "single monochromatic image" in green wherein the green color filter in figure 6 is the same as the claimed "said two filters of a single color."

Thus, the Examiner considers column 2, lines 33 and 35; column 9, lines 9-10; and Fig. 6 of Howell to disclose the feature of claim 1 <u>wherein the image</u>

processing unit generates and outputs a single monochromatic image using only pixel data detected by photo detectors corresponding to the two filters for the selected color of the three colors.

Column 2, lines 33 and 35, of Howell referred to by the Examiner is part of the longer passage in column 2, lines 30-41, of Howell which reads as follows (emphasis added):

> In order to capture the color data needed for reconstituting the image in color, one can use several primary color filters in succession as one records a series of photographs; each image captured will depict the scene as it appears in one primary color. Then, these images—each in one primary color—can be combined using electronic circuitry, typically software-controlled, to produce and display a final, composite image that is reasonably true in color distribution to the image that would be formed on the focal plane without any intervening color filters, i.e., a final image reasonably true to the colors of the scene being photographed.

While this passage of Howell refers to several captured images each being in a single primary color, it is submitted that Howell does not disclose an image processing unit which generates and outputs a single monochromatic image using only pixel data detected by photo detectors corresponding to the two filters for the selected color of the three colors as recited in claim 1.

This passage of Howell refers to electronic circuitry, typically software-controlled. Assuming arguendo that Howell's electronic circuitry corresponds to an image processing unit as recited in claim 1, it is submitted that Howell's electronic circuitry generates and outputs a single color image using pixel data detected by photo detectors corresponding to filters for all of

three colors, rather than generating and outputting a single monochromatic image using only pixel data detected by photo detectors corresponding to the two filters for the selected color of the three colors as recited in claim 1.

Column 9, lines 9-10, of Howell referred to by the Examiner refers to Fig. 6 of Howell referred to by the Examiner, and is part of the longer passage in column 8, line 66, through column 9, line 27, of Howell which reads as follows (emphasis added):

> FIG. 6 shows the data that the camera of the Preferred Embodiment of the present invention captures in two-shot operation. The positions of the array for the two shots are shown, respectively, by the two arrays at the top of FIG. 6, the ones joined by an addition sign (the 8×8 arrays being intended to represent an internal sub-array of the actual array, itself hundreds or even thousands of pixels on a side). The array on the right can be seen to result from a one-pixel shift to the right (or to the left) of the array on the left.
>
> As is emphasized in the middle arrays of FIG. 6, the result of having taken the two single shots will be to obtain actual measurement data for green for every single point. Moreover, as shown by the composite array at the bottom of FIG. 6, for the single color—red or blue—that needs to be interpolated at a given pixel, the interpolation procedure can draw on measurement data from all four nearest-neighbor elements and from two of the four next-nearest neighbors. For example, consider the element shown with the bold outline in FIG. 6. It has actual measurements for the luminous intensity of green and blue, and requires an interpolation to be done to determine the contribution that red will make to the composite image. Not only do six of the eight nearest- and next-nearest neighbor elements contain actual red data, but they also contain the red-to-green intensity ratio. In the present invention, it will be that data that will take dominance if its interpolated value at the element in question differs from the straight-forward interpolation of red.

That is, the software used to "assemble" the composite image is written to ensure that outcome.

It is submitted that it is readily apparent from this passage of Howell that Fig. 6 does not show images including a green image as apparently alleged by the Examiner, but that Fig. 6 merely shows arrays of red, blue, and green data that are combined by software to generate a composite color image. It is submitted that nothing whatsoever in this passage of Howell and Fig. 6 of Howell disclose an image processing unit which generates and outputs a single monochromatic image using only pixel data detected by photo detectors corresponding to the two filters for the selected color of the three colors as recited in claim 1.

It is submitted that Howell only discloses generating and outputting a color image in a single-shot operation; and generating and outputting a composite color image in a two-shot operation.

Accordingly, for the reasons discussed above, it is submitted that Howell does not disclose the feature of claim 1 wherein the image processing unit generates and outputs a single monochromatic image using only pixel data detected by photo detectors corresponding to the two filters for the selected color of the three colors.

Independent claim 6 recites an image processing method comprising the steps of picking up, with a color imaging device, an image of an object formed on an imaging surface by an imaging optical system, the color imaging device including a plurality of photo detectors arranged on the imaging surface, each of the photo detectors forming a pixel, and a plurality of sets of four filters for

three colors, two filters of the four filters being for a selected color of the three colors, the filters being arranged at positions respectively corresponding to the photo detectors, the image of the object being formed on the photo detectors through the filters by the imaging optical system, extracting pixel data of pixels corresponding to the two filters for the selected color of the three colors from image data of the image picked up, shifting the imaging optical system and the color imaging device relative to each other by a distance corresponding to 1/n (n is an integer) of a pixel on the imaging surface, picking up, with the color imaging device, the image of the object formed on the imaging surface after the shifting step, extracting pixel data of the pixels corresponding to the two filters for the selected color of the three colors from image data of the image picked up after the shifting step, and generating a monochromatic image by synthesizing a plurality of pixel data extracted before and after the shifting step.

In explaining the rejection of claim 6, the Examiner states as follows:

> In regards to claim 6 as being a method for using the device claimed in claim 1 see examiners notes on the rejection of claim 1.

However, it is submitted that Howell does not disclose generating a monochromatic image by synthesizing a plurality of pixel data extracted before and after the shifting step as recited in claim 6 for substantially the same reasons discussed above that Howell does not disclose the similar feature of claim 1.

Dependent claim 7 recites an image processing method according to claim 6, wherein the shifting step, the picking-up step after the shifting step, and the

extracting step after the shifting step are repeated a plurality of times for a plurality of different shift positions.

Claim 7 is directed to the feature of the present invention shown, for example, in Fig. 2C wherein a green image is generated by combining green image data obtained at eight different positions arrived at by performing seven shift operations.

In explaining the rejection of claim 7, the Examiner states as follows:

> In regards to claim 7 Howell discloses a "shifting step" as described in the rejection of claim 1 wherein in order to take a picture on Howell's camera on the "two-shot operation (column 6, line 52, Howell)" the camera takes a picture, which entails extracting data from the photo detectors, namely the green color filter's photo detectors, shifts the light-sensitive array, takes a picture, shifts the light-sensitive array back to its starting position or in other words "said shifting step, said image pickup step and said extraction step are executed repeatedly a plurality of times for different shift positions."

However, in Howell's two-shot operation referred to by the Examiner, a shifting step, a picking-up step after the shifting step, and an extracting step after the shifting step are performed a single time for a single shift position, rather than being repeated a plurality of times for a plurality of different shift positions as recited in claim 7.

Accordingly, for the reasons discussed above, it is submitted that Howell does not disclose the feature of claim 7 wherein the shifting step, the picking-up step after the shifting step, and the extracting step after the shifting step are repeated a plurality of times for a plurality of different shift positions.

New dependent claim 8 recites an image processing apparatus according to claim 1, wherein the image processing unit also generates a color image using a plurality of image data picked up before and after the shifting, and wherein the image processing apparatus further comprises an output unit for selectively outputting one of the single monochromatic image and the color image.

Claim 8 is directed to the feature of the present invention described, for example, on page 9, line 27, through page 10, line 4, of the specification.

It is submitted that Howell only discloses generating and outputting a color image in a single-shot operation, and generating and outputting a composite color image in a two-shot operation. Accordingly, it is submitted that Howell does not disclose an output unit for selectively outputting one of the single monochromatic image and the color image as recited in claim 8.

New independent claim 12 recites an image processing method comprising the steps of picking up, with a color imaging device, an image of an object formed on an imaging surface by an imaging optical system, extracting pixel data of pixels corresponding to a single color from image data of the image picked up, shifting the imaging optical system and the color imaging device relative to each other, picking up, with the color imaging device, the image of the object formed on the imaging surface after the shifting step, extracting pixel data of the pixels corresponding to the single color from image data of the image picked up after the shifting step, and generating a monochromatic image by synthesizing the pixel data extracted before and after the shifting step.

It is submitted that Howell does not disclose generating a monochromatic image by synthesizing the pixel data extracted before and after the shifting step as recited in claim 12 for substantially the same reasons discussed above that Howell does not disclose the similar features of claim 1 and 6.

New dependent claim 14 recites an image processing method according to claim 12, wherein the color imaging device includes a plurality of photo detectors arranged on the imaging surface, each of the photo detectors forming a pixel, and a plurality of sets of four filters for three colors including the single color, two filters of the four filters being for the single color, the filters being arranged at positions respectively corresponding to the photo detectors, the image of the object being formed on the photo detectors through the filters by the imaging optical system, wherein in the shifting step, the imaging optical system and the color imaging device are shifted relative to each other by a distance corresponding to a predetermined number of pixels on the imaging surface, and wherein the generating step generates a single monochromatic image using only pixel data detected by photo detectors corresponding to the two filters for the single color.

It is submitted that Howell does not disclose the feature of claim 14 wherein the generating step generates a single monochromatic image using only pixel data detected by photo detectors corresponding to the two filters for the single color for substantially the same reasons discussed above that Howell does not disclose the similar features of claims 1, 6, and 12.

Since Howell does not disclose the features of claims 1, 6-8, 12, and 14 discussed above, it is submitted that claims 1, 6-8, 12, and 14 and claims 2-5, 9-11, and 13 depending from claims 1, 6, and 12 patentably distinguish over Howell in the sense of 35 USC 102(a), and it is respectfully requested that the rejection of claims 1-7 under 35 USC 102(a) as being anticipated by Howell be withdrawn.

Although dependent claims 2-5, 9-11, and 13 are considered to be allowable by virtue of their dependency from allowable independent claims 1, 6, and 12, it is noted that these dependent claims also recite further features of the present invention which are not seen to be disclosed or suggested by the prior art at least in combination with all of the other features recited in independent claims 1, 6, and 12 from which they depend.

As recognized by the Examiner, the other references cited but not relied upon neither disclose nor suggest the present invention, and thus no further discussion of these other references is deemed necessary at this time.

It is submitted that all of the Examiner's objections and rejections have been overcome, and that the application is now in condition for allowance. Reconsideration of the application and an action of a favorable nature are respectfully requested.

To the extent necessary, the applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, or credit any

overpayment of fees, to the deposit account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (500.40886X00).

Respectfully submitted,

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Attachments

APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

Changes made to the application by the present amendment are indicated below, with brackets indicating deleted matter and underlining indicating added matter.

IN THE CLAIMS

New claims 8-14 have been added.

Claims 1-7 have been amended as follows:

--1. (Amended) An image processing apparatus comprising:

an imaging optical system for forming an image of an object on an imaging surface;

a color imaging device including

a plurality of photo detectors arranged on [said] the imaging surface, each of [said] the photo detectors forming a pixel, and

a [multiplicity] plurality of sets of four filters for three colors, two filters of [said] the four filters being [used] for a selected [one] color of [said] the three colors, [said] the

filters being arranged at positions respectively corresponding to [said] the photo detectors, [respectively,]

[said] the image of the object [image] being formed on [said] the photo detectors through [each of said] the filters by [said] the imaging optical system;

shift drive means for shifting [said] the imaging optical system and [said] the photo detectors [relatively] relative to each other by a [length] distance corresponding to a predetermined number of pixels [in said] on the imaging surface; and

an image processing unit for generating an image using a plurality of image data picked up before and after [said shift] the shifting;

wherein [said] the image processing unit generates and outputs a single monochromatic image using only [the] pixel data detected by [the] photo detectors [having said] corresponding to the two filters [of a single] for the selected color of the three colors.

2. (Amended) An image processing apparatus according to [Claim] claim 1, wherein [said] the color filters are arranged according to [the] a Bayer scheme.

3. (Amended) An image processing apparatus according to [Claim] claim 1, wherein [said] the shift drive means shifts [said] the imaging optical system and [said] the photo detectors [relatively] relative to each other by a [length]

distance corresponding to 1/n (n[:] is an integer) of a pixel on the imaging surface.

4. (Amended) An image processing apparatus according to [Claim] claim 1, wherein [said single] the selected color [used by said two filters] of the three colors is green.

5. (Amended) An image processing apparatus according to [Claim] claim 1, wherein [said] the image processing unit interpolates [the] pixels lacking [the] pixel data of [said single] the selected color of the three colors in [an] one of the plurality of image data with [the] pixel data in another one of the plurality of image data.

6. (Amended) An image processing method comprising the steps of:

picking up, [the] with a color imaging device, an image of an object formed on [the] an imaging surface [of] by an imaging optical system, [by a] the color imaging device including

a plurality of photo detectors arranged on the imaging surface, each of the photo detectors forming a pixel, and

a [multiplicity] plurality of sets of four filters for three colors, two filters of [which process] the four filters being for a selected [one] color of the three [primary] colors, [said] the filters being arranged at positions respectively corresponding

to [said] the photo detectors, [respectively, on said imaging surface;]

the image of the object being formed on the photo detectors through the filters by the imaging optical system;

extracting [the] pixel data of [the] pixels corresponding to [said] the two filters [of a single] for the selected color of the three colors from [the] image data of [said] the image picked up;

shifting [said] the imaging optical system and [said] the color imaging device relative to each other by a [length] distance corresponding to 1/n (n[:] is an integer) of a pixel [relatively to each other in said] on the imaging surface;

picking up, [by said] with the color imaging device, the image of the object formed on [said] the imaging surface after [said shift] the shifting step;

extracting [the] pixel data of the pixels corresponding to [said] the two filters [of a single] for the selected color of the three colors from [the] image data of [said] the image picked up after [said shift] the shifting step; and

generating a monochromatic image by synthesizing a plurality of pixel data extracted before and after [said shift] the shifting step.

7. (Amended) [A] An image processing method according to [Claim] claim 6, wherein [said] the shifting step, [said image pick-up] the picking-up step after the shifting step, and [said extraction] the extracting step after the shifting step

are [executed repeatedly] repeated a plurality of times for a plurality of different shift positions.--